CLAIMS

1. A chemical reactor for nitrogen oxide emission control, comprising a electrochemical cell with a four-layer structure consisting of an upper cathode (catalyst reaction component) and a lower cathode (positive electrode) composed of an electron-conductive substance and an ion-conductive substance, a solid electrolyte having oxygen ion conductivity, and an anode (negative electrode), wherein the volumetric ratio of the electron-conductive substance and ion-conductive substance that make up the upper cathode is from 3:7 to 7:3.

2. The chemical reactor according to Claim 1, wherein the volumetric ratio of the electron-conductive substance and ion-conductive substance that make up the upper cathode is from 3:7 to 5:5.

3. The chemical reactor according to Claim 1 or 2, wherein the electron-conductive substance of the upper cathode is composed of nickel and nickel oxide, and the ion-conductive substance is composed of zirconia stabilized with yttrium oxide or scandium oxide.

4. The chemical reactor according to Claim 1, wherein the electron-conductive substance of the lower cathode is composed of platinum and/or palladium, and the ion-conductive substance is composed of zirconia stabilized with yttrium oxide or scandium oxide.

5. The chemical reactor according to Claim 1, wherein the solid electrolyte is composed of zirconia stabilized with yttrium oxide or scandium oxide.

6. The chemical reactor according to Claim 1, wherein the anode is composed of an electron-conductive substance and an ion-conductive substance, and the volumetric ratio of the electron-conductive substance and ion-conductive substance is from 3:7 to 7:3.

7. The chemical reactor according to Claim 7, wherein the electron-conductive substance of the anode is composed of platinum and/or palladium, and the ion-conductive substance is composed of zirconia stabilized with yttrium oxide or scandium oxide.

8. A method for the emission control of nitrogen oxides with the chemical reactor according to any of Claims

1 to 7, wherein nitrogen oxides are emission-controlled at the upper cathode by applying voltage between the lower cathode and the anode of the electrochemical cell.

9. A chemical reactor for subjecting a treatment substance to a chemical reaction, comprising a chemical reaction layer where the chemical reaction of the treatment substance proceeds, and an electrode layer that is adjacent to the chemical reaction layer, the electrode layer having the function of conducting electrons to the chemical reaction layer and conducting to outside the system ionized elements produced in the chemical reaction layer.

10. The chemical reactor according to Claim 9, wherein the electrode layer is composed of an oxide, a metal, or a mixture of both.

11. The chemical reactor according to Claim 9, wherein the electrode layer is composed of an electron-conductive phase that conducts electrons given for ionizing elements contained in the treatment substance in the chemical reaction layer, and an ion-conductive phase that conducts elements ionized by the chemical reaction.

12. The chemical reactor according to Claim 9, wherein the mixing ratio of the ion-conductive phase and the electron-conductive phase in the electrode layer is in the range of ion-conductive phase:electron-conductive phase = 3:7 to 7:3.

13. The chemical reactor according to Claim 9, wherein the treatment substance is a nitrogen oxide, the nitrogen oxide is reduced into oxygen ions in the chemical reaction layer, and the oxygen ions are conducted in the ion-conductive phase of the electrode layer.

14. A method for removing nitrogen oxides in an exhaust gas with an electrochemical cell that decomposes or removes nitrogen oxides, wherein exhaust gas from a combustor is pretreated in advance with a nitrogen oxide adsorption material that adsorbs nitrogen oxides at low temperatures until the temperature of the exhaust gas rises, and releases nitrogen oxides at high temperatures after the temperature of the exhaust gas has risen, and this pretreated exhaust gas is treated with an electrochemical cell.

15. The method for removing nitrogen oxides according to Claim 14, wherein pretreatment is performed using a nitrogen oxide adsorption material that adsorbs nitrogen oxides at low temperatures from room temperature up to 400°C, and releases nitrogen oxides at high temperatures over 400°C.

16. A nitrogen oxide removal system, wherein a nitrogen oxide adsorption component composed of a nitrogen oxide adsorption material is provided at the upstream part of an electrochemical cell that decomposes or removes nitrogen oxides in an electrochemical cell component made up of said electrochemical cell.

17. The nitrogen oxide removal system according to Claim 16, which is an apparatus for decomposing or removing nitrogen oxides using an electrochemical cell comprising at least three layers, consisting of a solid electrolyte of an oxygen ion conductor, a cathode, and an anode, wherein a nitrogen oxide adsorption component is provided ahead of the gas inlet of said apparatus.

18. The nitrogen oxide removal system according to Claim 16, wherein the nitrogen oxide adsorption component is composed of a nitrogen oxide adsorption material that

adsorbs nitrogen oxides at low temperatures from room temperature up to 400°C, and releases nitrogen oxides at high temperatures over 400°C.

19. A chemical reactor for subjecting a treatment substance to a chemical reaction, wherein a surface coating layer that inhibits the ionization reaction of adsorbed oxygen on the surface of a chemical reaction component where the chemical reaction of the treatment substance proceeds is formed on said chemical reaction component surface.

20. The chemical reactor according to Claim 19, wherein the surface coating layer is composed of an ion-conductive substance, a mixed conductive substance, or an insulating substance.

21. The chemical reactor according to Claim 19 or 20, wherein the chemical reaction component is composed of a reduction phase that produces ions by supplying electrons to elements contained in the treatment substance, an ion-conductive phase that conducts these ions from the reduction phase, and an oxidation phase that releases electrons from the ions conducted through this ion-conductive phase.

22. The chemical reactor according to any of Claims 19 to 21, wherein the treatment substance is a nitrogen oxide, the nitrogen oxide is reduced into oxygen ions in the reduction phase, and the oxygen ions are conducted in the ion-conductive phase.

23. The chemical reactor according to Claim 19 or 20, wherein the ionization reaction inhibition layer or surface coating layer has a structure or material that blocks the conduction path by which current supplied from the outside to the chemical reaction component reaches the adsorption point of oxygen molecules.